proposed mound is considered to represent a conservative assessment. The small wave attenuation effects that will be associated with the existing remnant caissons indicate that the actual differences between pre and post project conditions will be slightly less than estimated.

The proposed bird roosting platform support piles will impact existing wave climate much less because of their smaller profile, spacing, and number. Therefore, it is estimated that their influence on coastal processes will be negligible.

3.2 Impact Assessment

Because the same offshore wave conditions were used in the simulations of nearshore processes for the without and with structure scenarios, the differences in the simulated wave characteristics, wave-induced circulation and sediment transport potential represent the changes to an existing conditions that might be expected from the proposed hardbottom substrate feature. These changes are discussed in the following sections.

3.2.1 Impacts to the Nearshore Wave Climate

Figure 7 shows the absolute and relative differences in the predicted breaking wave heights between the with-structure and without-structure scenarios. It is seen that refraction, diffraction, and shoaling effects due to the localized and more shallow depth of the quarry stone mound will cause some sheltering effects inshore of the structure and slight increases in height within relatively narrow zones on both upcoast and downcoast sides. Because of the nearly unidirectional (westerly) wave approach in the central Santa Barbara Channel, the shelter zone is estimated to predominate within an area immediately downcoast of the PRC-421 site.

The decreases and increases in wave height are estimated to be within 0.20 feet (0.06 meter) of the existing conditions (about five percent). Therefore, the impact of the structure on the nearshore wave climate is deemed to be insignificant.

T17

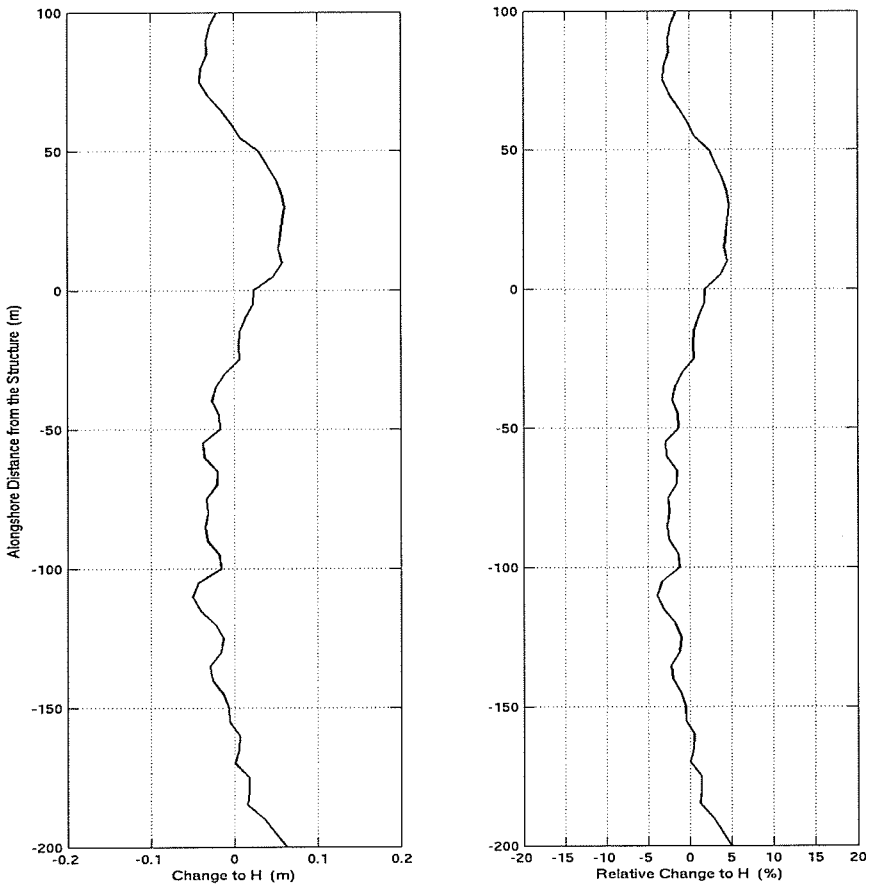

Figure 7. Impacts to Breaking Wave Heights

3.2.2 Impacts to the Nearshore Currents

Because nearshore currents are directly related to incident wave conditions, changes to the local inshore currents are anticipated to mimic the same decrease and increase pattern discussed above for wave climate. The predicted maximum changes to the along-shore (towards downcoast) and cross-shore (seaward) current velocity are shown in Figures 8 and 9, respectively.

T18

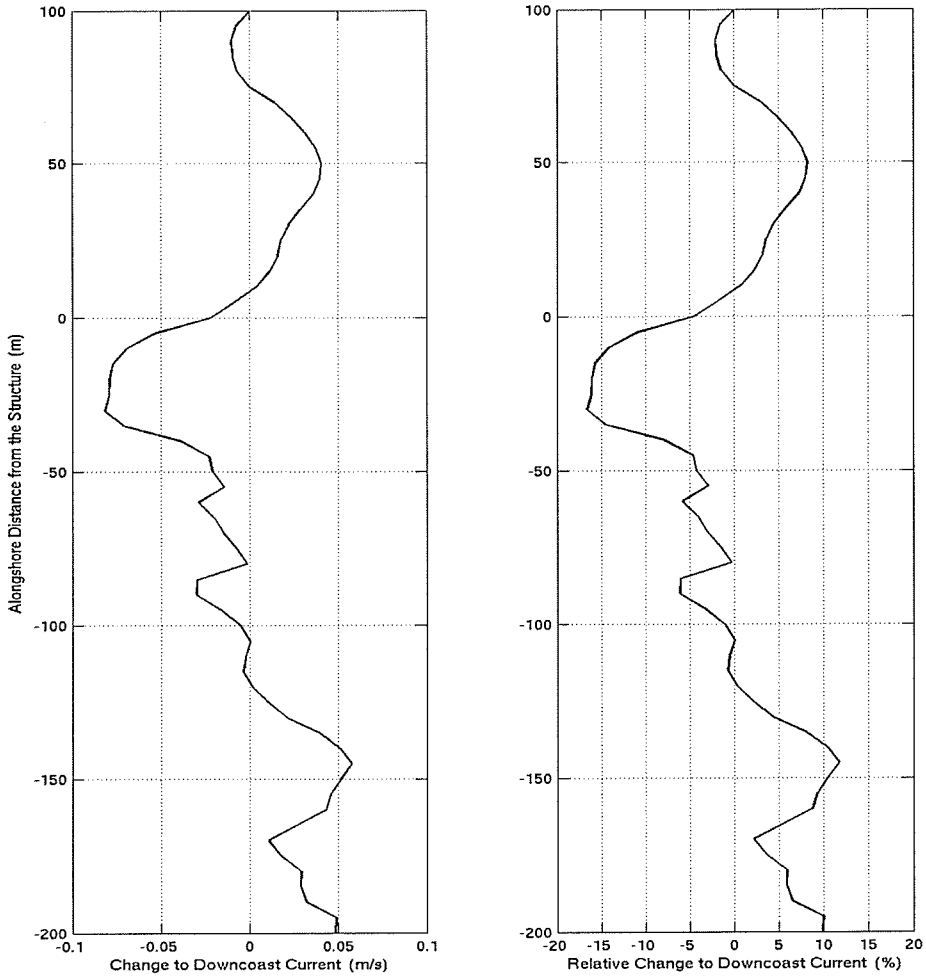

Figure 8. Impacts to Alongshore (Downcoast) Currents

Figures 8 and 9 indicate that the submerged mound will decrease the along-shore and cross-shore currents by no more than 16 percent within the wave shelter zone. Current velocities within the areas of elevated wave height are expected to not exceed 15 percent. However, this is considered to have a less than significant impact on nearshore currents.

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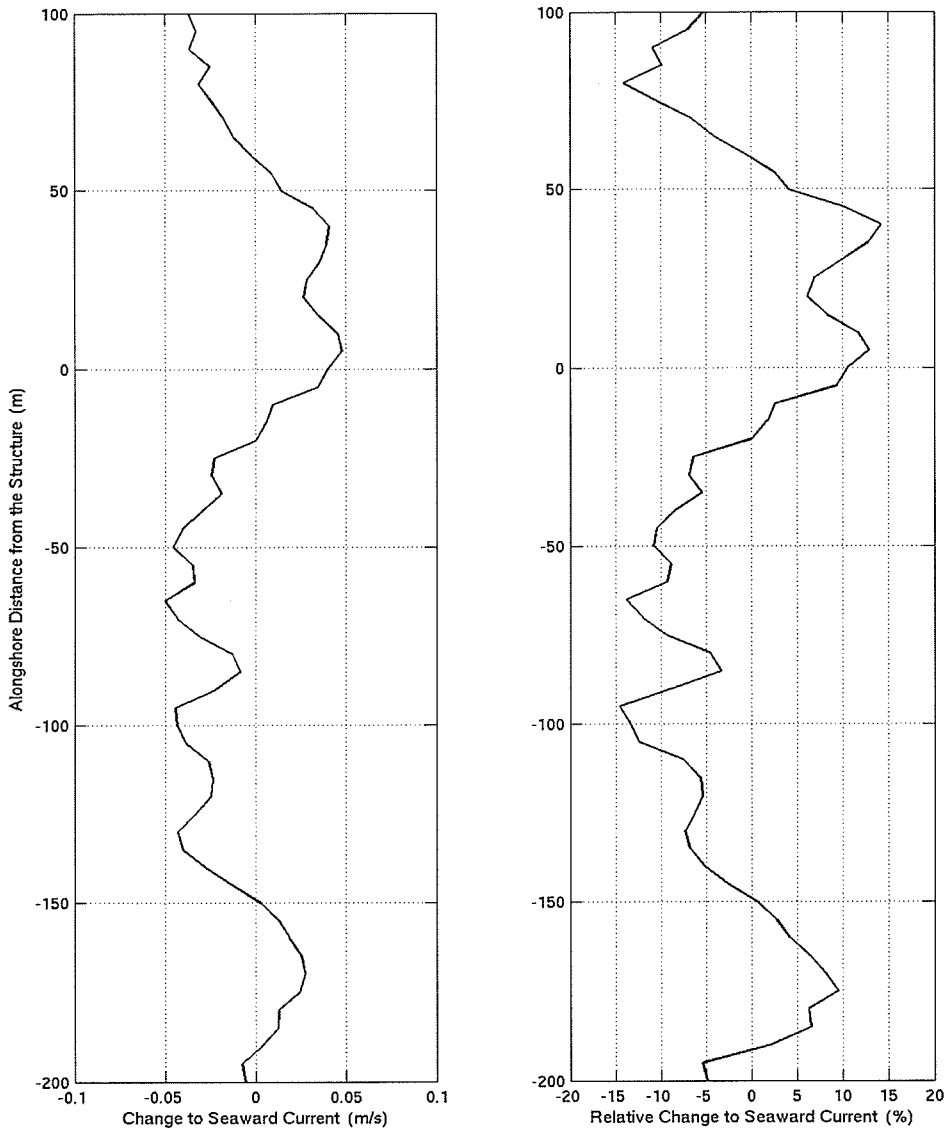

Figure 9. Impacts to Cross-Shore (Seaward) Currents

3.2.3 Impacts to the Sediment Transport

The estimated change to the along-shore, shoreline parallel sediment transport rate caused by the structure is shown in Figure 10. It is seen that the along-shore sediment transport potential within the wave shelter zone may decrease by less than 45,000 cubic

T20

yards (35,000 cubic meters) per year or about 16 percent of the existing transport rate, while it may increase by as much as 33 percent within the narrow zones of increased wave energy. This is considered to have a less than significant impact on local sediment transport.

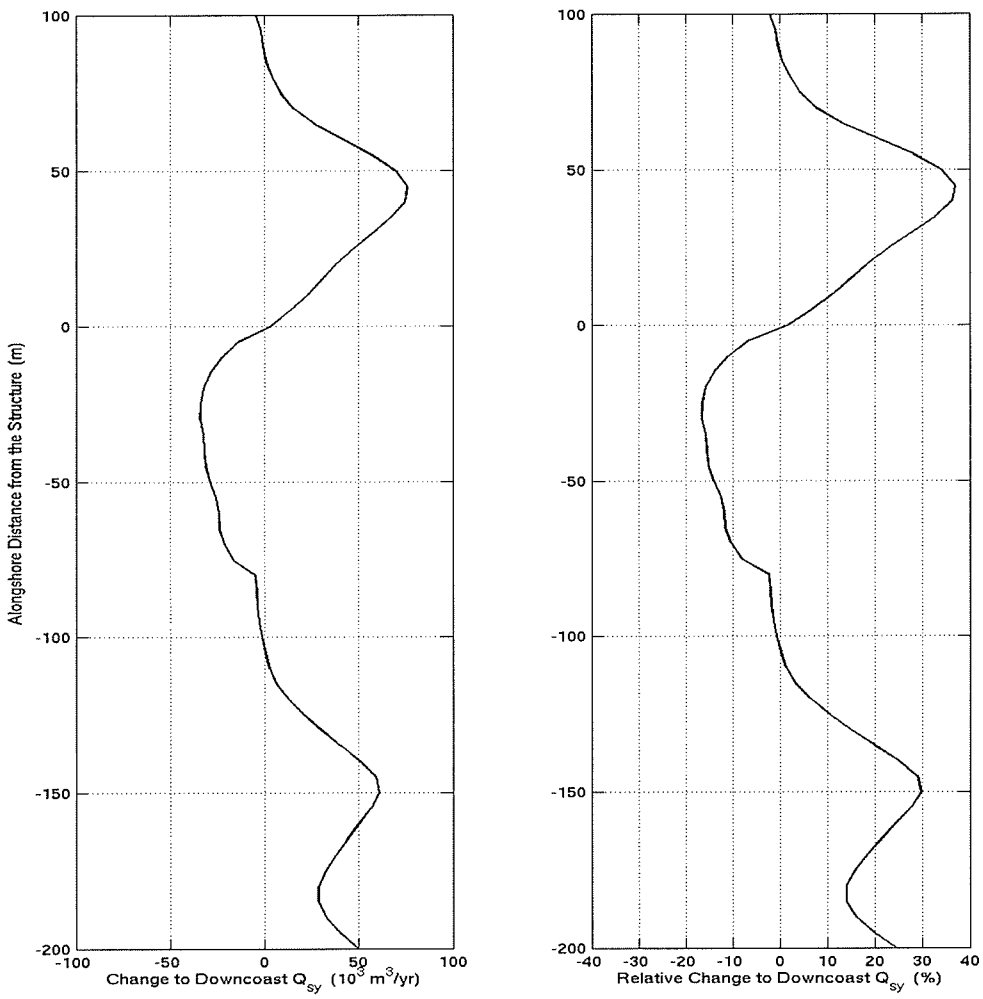

Figure 10. Impacts to Along-shore (Downcoast) Sediment Transport Potential

Figure 11 shows the change to the cross-shore (seaward) sediment transport rate per unit width. The maximum value in each cross-section is presented in this figure. It is seen that the cross-shore sediment transport potential may decrease by about 11 percent or less within the zone of wave shelter. Increase of no more than approximately

T21

30 percent are estimated to occur within the upcoast and downcoast zones where wave heights will be elevated.

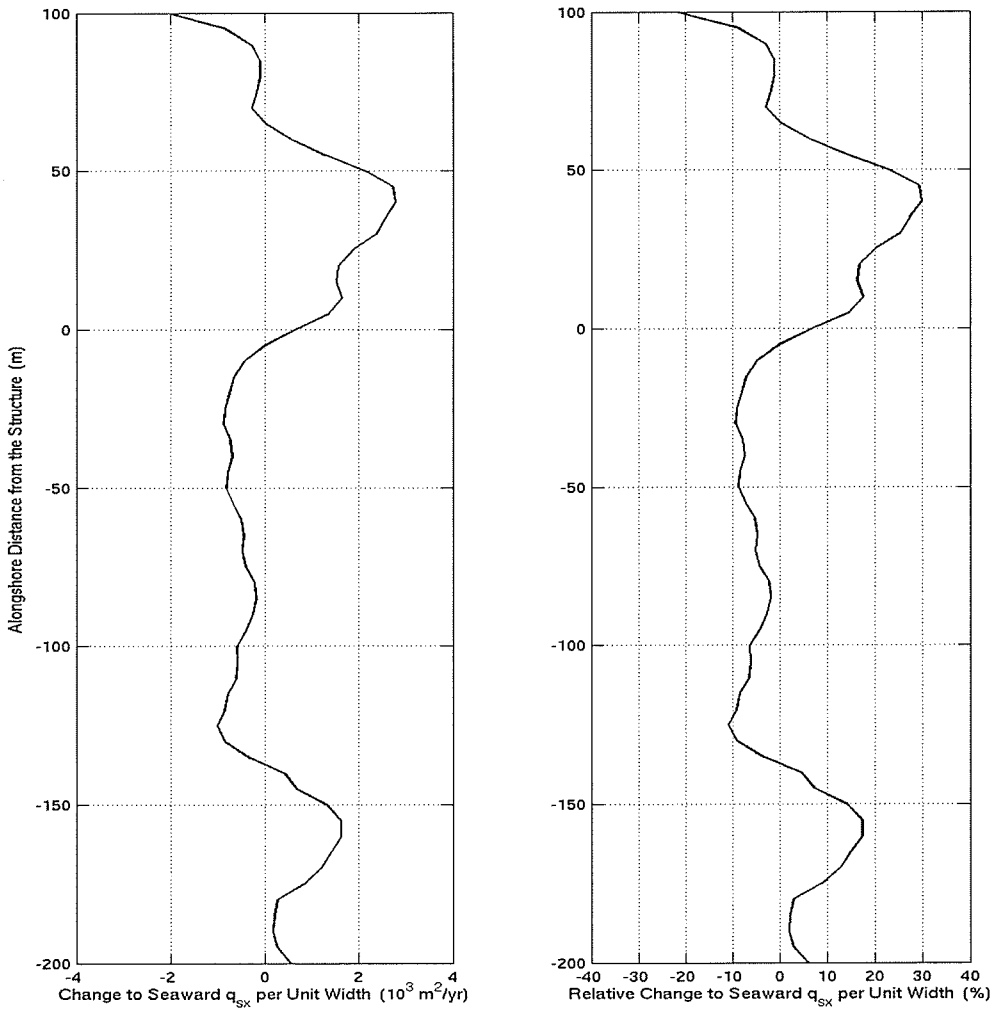

Figure 11. Potential Impacts to Cross-shore (Seaward) Sediment Transport Potential Per Unit Width

4. SUMMARY AND CONCLUSIONS

The proposed submerged hardbottom substrate feature will alter a relatively small area of existing rocky bottom area. The local bathymetry within a 170-foot (52-meter) diameter footprint will decrease the water depth approximately 10 feet (3.0 meters) from 32 to 34 feet (9.8 to 10.4 meters) MLLW to about 23 to 25 feet (7.0 to 7.6 meters) MLLW at the PRC-421 remnant structure location. The elevated feature is estimated to result in modest but insignificant changes to the nearshore wave climate within the immediate vicinity of the site. As a consequence of this effect, corresponding insignificant changes to the nearshore currents, sediment transport processes, and beach evolution may occur as well.

Wave Climate

The submerged structure will result in relatively small changes to the incident sea and swell energy that will pass over and near the submerged mound. Refraction, diffraction, and shoaling effects due to the localized and shallow depth of the quarry stone mound are estimated to result in some sheltering effects inshore of the structure and slight increases in wave height within relatively narrow zones immediately upcoast and downcoast of the mound location.

Because of the nearly unidirectional (westerly) approach of sea and swell in the central Santa Barbara Channel, the limits of the wave shelter area influenced by the submerged mound are estimated to be mostly confined within about 390 feet (120 meters) of surf zone area immediately inshore and downcoast of the PRC-421 site. The narrow zones of elevated wave height that are predicted to occur on either side of the mound are estimated to result in slightly higher surf conditions in those areas. The predicted changes to the local wave climate are estimated to be within five percent of existing conditions. Therefore, the impact of the structure on the nearshore wave climate is deemed to be insignificant.

T23

Nearshore currents and alongshore sediment transport

Because nearshore currents are directly related to incident wave conditions, changes to the local inshore currents are anticipated to mimic the same decrease and increase pattern discussed above for wave climate. The numerical model studies indicate that the submerged mound will decrease the alongshore and cross-shore currents by no more than 16 percent within the wave shelter zone. Current velocities within the areas of elevated wave height are expected to not exceed 15 percent.

The along-shore sediment transport potential within the wave shelter zone is estimated to decrease by less than 45,000 cubic yards per year or about 16 percent of the existing transport rate. The numerical model results imply that littoral transport may increase as much as 33 percent within the narrow zones of increased wave energy. The net effect of these changes is anticipated to result in times of slightly increased beach width inshore of the PRC-421 mound and occasions when more narrow beach width will occur for short distances immediately upcoast and downcoast of the site. The changes that may result are estimated to be less than the magnitude of the normal seasonal beach width changes that presently occur along this shoreline. Seasonal berm width variation and short term storm changes are at least 50 feet (15 meters) at Ellwood. More severe storm events will temporarily denude the beach of all sand. The proposed improvements are not expected to impact this existing process.

Cross-shore sediment transport

The cross-shore sediment transport potential is estimated to decrease by about 11 percent or less within the zone of wave shelter. Increases of no more than approximately 30 percent are estimated to occur within the upcoast and downcoast zones where wave heights will be elevated. This implies corresponding decreases and increases in cross-shore sediment transport within the respective areas.

Beach profile data surveyed at Ellwood since 1987 indicates that cross-shore sediment transport is mostly confined to areas inshore of the –30 foot (9 meters), MLLW depth. The predominance of rock outcrop and kelp in and around the PRC-421 structure remnant site suggests that onshore-offshore exchanges of sand are mostly confined to

T24

the more shallow depths. Accordingly, it is estimated that the relatively deep water location of the offshore mound will not result in significant entrapment of sand.

Recession of the sandy beach may increase during storm events over the narrow upcoast and downcoast sections. However, the net effect is estimated to be insignificant when compared to the naturally occurring sediment limited conditions of the Ellwood shoreline. The potential along-shore and cross-shore rates of sediment transports for the existing conditions already exceed the available sediment supply. Thus, when more severe storm events occur, all sand from the beach is temporarily removed down to a resistant cobble and rock substrate level. It is during these times of depleted sand that the bluffs are vulnerable to and can experience episodes of toe erosion. The proposed offshore mound is estimated to not significantly alter this process.

T25

5. REFERENCES

Bailard J. A., 1981. An energetics total load sediment transport model for a plane sloping beach. J. Geophys. Res., 86(c11), 10938-10954.

CDIP Website, http://cdip.ucsd.edu/tmp/stream_frame11307.html.

Coastal Frontiers Corporation, beach profiles surveyed for BEACON.

Diener, B.G., 2000. Sand contribution from bluff recession between Point Conception and Santa Barbara, California, Shore & Beach, Vol 68, No. 2, April 2000.

Fairweather Pacific, LLC, 2003. PRC-421 remant structure removal, California brown pelican mitigation project information packet.

Flick, R.E. and D.R. Cayan. Extreme sea levels on the coast of California, Proceedings of the 19th Coastal Engineering Conference, pages 886-898.

Fugro West, Inc., 2001. Map showing ARCO Pier PRC-421. Prepared for Fairweather LLC, March 2001.

Kirby J. T. and R. A. Dalrymple, 1994. Combined refraction/diffraction model REF/DIF1, Version 2.5. CACR-92-22, University of Delaware .

Qin, W., 2003. Modeling Nearshore Processes. Ph.D thesis, University of Delaware.

Noble Consultants, Inc. 1989. Coastal sand management plan, Santa Barbara/ Ventura County coastline. Prepared for BEACON, July 14, 1989.

Svendsen I. A., K. Haas and Q. Zhao, 2002. Quasi-3D nearshore circulation model SHORECIRC, Version 2.0. CACR report, University of Delaware.

Wiegel, R. L., 1964. Oceanographical Engineering. Prentice-Hall, Inc.

T26